

10/578201

AP20 Rec'd PCT/PTO 04 MAY 2006


VERIFICATION OF TRANSLATION

I, DAVID CLAYBERG

of 948 15th St., Ste. 4
Santa Monica, CA 90403-3134

declare that I am a professional translator well acquainted with both the German and English languages, and that the attached is an accurate translation, to the best of my knowledge and ability, of the accompanying German document.

Signature


David Clayberg

Date

10/10/2005

Tool-Holding Device For an Insert Tool With an At Least Essentially Disk-Shaped Hub

Prior Art

5

The present invention is based in particular on a tool-holding device according to the preamble to claim 1.

DE 100 17 458 A1 has disclosed a species-defining tool-holding device of
10 an angle grinder for an insert tool with a disk-shaped hub. The tool-holding device has a drive shaft and a drive device; the insert tool can be operationally connected to the drive device by means of three locking elements of the drive device that are supported so that they can move in relation to a spring element, which locking element engages in a locking fashion in the operating position of
15 the insert tool and fixes the insert tool in a form-locked manner in the circumference direction. The drive shaft is connected to a drive flange of the drive device in a frictionally engaging manner in the circumference direction.

Advantages of the Invention

20

The present invention is based on a tool-holding device for an insert tool with an at least essentially disk-shaped hub, in particular for a hand-guided angle grinder or a hand-guided circular saw, having a drive shaft and a drive device that has at least one locking element movably supported against a spring
25 element for fixing the insert tool in a form-locked manner in the circumference direction.

According to the present invention, the drive shaft has at least one form-locking element formed onto it in a non-cutting manner in order to connect it in a
30 form-locked manner in the circumference direction to a drive torque-transmitting

mechanism of the drive device. A structurally simple, inexpensive connection between the drive shaft, the mechanism of the drive device, in particular a drive flange, and the insert tool can be achieved that is able to transmit powerful torques, particularly in that inexpensive, large transmission surface areas can be achieved at least without significant material weakening. The design according to the invention is thus particularly suited for high-powered machines, in particular for line-powered machines. The drive shaft can essentially be constituted by a motor shaft, an output shaft of a transmission, in particular an angle transmission, or by a shaft that adjoins an output shaft of a transmission in the direction toward the insert tool.

The form-locking element can be constituted by an integrally formed groove in which an additional, for example tooth-like transmission mechanism can be fastened, which permits the material properties of this transmission mechanism to be selectively brought into line with the stresses that are present, or the form-locking element can advantageously be used to directly contact the mechanism of the drive device or the drive flange, which makes it possible to reduce the number of additional components, complexity of assembly, and costs.

If the form-locking element is formed onto the drive shaft by means of a pressing procedure, then this can be advantageously implemented inexpensively and within strict tolerances. In addition to a pressing procedure, however, there are also other conceivable methods that those skilled in the art will deem suitable for forming the form-locking element onto the drive shaft in a non-cutting fashion, for example a casting process, etc.

In another embodiment of the present invention, the form-locking element has a greater longitudinal span in the axial direction of the drive shaft than its height, which makes it possible to achieve, in a particularly space-saving

manner, large transmission surface areas and the resulting low surface pressures and low wear.

If the drive shaft has at least three form-locking elements, then an
5 advantageously uniform force distribution can be achieved with a large total transmission surface area. It is also conceivable, however, to provide only one or two form-locking elements.

In another embodiment, the inner circumference of the mechanism of the
10 drive device has at least one continuous axial groove that constitutes a form-locking element, which makes it possible to achieve a particularly inexpensive manufacture of the mechanism, particularly if this is comprised of a sintered part.

If the mechanism of the drive device is comprised with a drive flange that
15 constitutes a contact surface for the insert tool, then it is possible to reduce the number of additional components, the amount of space required, the complexity of assembly, and costs.

In another embodiment of the present invention, the mechanism of the
20 drive device is supported on the drive shaft by means of a spacer element. The manufacturing process-induced transitions between the form-locking element and adjoining regions can advantageously be bridged over by the spacer element, thus making it unnecessary to provide the mechanism of the drive device with expensive contours corresponding to the transitions. The spacer
25 element is advantageously comprised of a sleeve that is easy to install and makes it possible to achieve a uniform support in a structurally simple way.

According to another embodiment, the tool-holding device includes a leaf
spring unit that has at least one freely extending spring piece that extends at
30 least partially in the circumference direction, which makes it possible to

inexpensively produce a space-saving leaf spring unit that has an easy-to-manufacture contour and achieves an advantageous transmission of force. In this context, the term "freely extending spring piece" is understood to be a spring piece with at least one freely extending end.

5

If the spring piece is connected to a retaining ring by means of at least one connecting piece extending at least essentially in the radial direction, in particular radially inward, then it is possible to achieve an advantageous stress distribution in the leaf spring unit that is particularly easy to predetermine.

10 Basically, however, the spring piece could also extend outward essentially without a radial connecting piece, for example in a spiral shape.

Drawings

15

Other advantages ensue from the following description of the drawings. The drawings show an exemplary embodiment of the present invention. The drawings, the specification, and the claims contain numerous features in combination. Those skilled in the art will also suitably consider the features
20 individually and unite them in other meaningful combinations.

Fig. 1 schematically depicts a top view of an angle grinder,

Fig. 2 is an exploded view of a tool-holding device with a hub of an insert
25 tool,

Fig. 3 is an enlarged depiction of a drive flange from Fig. 2, and

Fig. 4 is an enlarged depiction of a leaf spring unit from Fig. 2.

30

Description of the Exemplary Embodiment

Fig. 1 shows a top view of an angle grinder 32 with an electric motor, not shown in detail, supported in a housing 34. The angle grinder 32 can be guided by means of a first handle 36 extending in the longitudinal direction and integrated into the housing 34 at an end oriented away from the insert tool 14 and by means of a second handle 40 extending transversely in relation to the longitudinal direction, attached to the transmission housing 38 in the region of the insert tool 14. The electric motor can drive the insert tool 14 to rotate via an angle transmission, not shown in detail, and a tool-holding device that includes a drive shaft 16 and a drive device 12 (Fig. 2).

For drive torque transmission, the drive shaft 16 comprised of an output shaft of the angle transmission, at its free end, has three form-locking elements 100 formed onto it in a non-cutting way by means of an extrusion process for a form-locked connection in the circumference direction 50, 52 to a drive flange 30 of the drive device 12, which flange constitutes a contact surface 30 for the insert tool 14. After the extrusion process, an internal thread 136 is let into the drive shaft 16, the drive shaft 16 is remachined by means of turning, then case hardened, and then ground in certain regions, particularly in bearing regions.

The form-locking elements 100 have a longitudinal span 102 in the axial direction 64 of the drive shaft 16 that is greater than their height 104 and are embodied with a rectangular cross sectional area.

In the assembled state, the form-locking elements 100 of the drive shaft 16, in order to transmit drive torque directly to the drive flange 10, engage in form-locking elements 106 constituted by continuous grooves (Figs. 2 and 3) formed into the inner circumference of the drive flange 10, which is comprised of

a sintered component. The drive flange 10 is centered by the outer surfaces of the form-locking elements 100 oriented radially outward.

5 In the axial direction 64, the drive flange 10 is supported on a collar 130 of the drive shaft 16 by means of a spacer element 108 embodied in the form of a sleeve. The spacer element 108 covers over a manufacture-induced transition 132 between a region at the free end of the drive shaft 16 characterized by the form-locking elements 100 and a region adjoining it in the axial direction 64.

10 On a side oriented toward the insert tool 14, the drive flange 10 has a collar 26 formed onto it, which radially centers the insert tool 14 with its centering bore 46 when the insert tool is in the installed position. The collar 26 has three shaped elements 22 situated on it, which are constituted by projections extending radially outward. The shaped elements 22 integrally joined to the
15 collar 26 are distributed uniformly around an outer circumference of the collar 26 and in the axial direction 54, 64, are spaced a distance 28 apart from the contact surface 30. With its end oriented toward the insert tool 14, the collar 26 protrudes beyond the shaped elements 22 in the axial direction 54.

20 On a side of the drive flange 10 oriented away from the insert tool 14, there is a sheet metal plate 48 equipped with three clamping hooks 56 integrally formed onto it that are uniformly distributed in the circumference direction 50, 52 and extend in the axial direction 54, which are for axially fixing the insert tool 14. The clamping hooks 56 are formed onto the sheet metal plate 48 in a bending
25 process.

During assembly of the drive device 12, the drive flange 10, a leaf spring unit 58, and the sheet metal plate 48 are preassembled. To accomplish this, the leaf spring unit 58 is slid onto a collar of the drive flange 10 that points in the
30 direction away from the insert tool 14. Then, the clamping hooks 56 of the sheet

metal plate 48, whose free ends have a hook-shaped extension with an inclined surface 94 oriented in the circumference direction 52, are guided in the axial direction 54 through openings 60 in the drive flange 10 (Figs. 2 and 3). By pressing the sheet metal plate 48 and the drive flange 10 together and rotating them in relation to each other, the leaf spring unit 58 is preloaded and the sheet metal plate 48 and the drive flange 10 are connected in a form-locked manner in the axial direction 54, 64 (Figs. 2 and 3). The sheet metal plate 48, loaded by the leaf spring unit 58, is then supported against the contact surface 30 of the drive flange 10 via edges of the hook-shaped extensions, which point axially in the direction away from the insert tool 14.

The leaf spring unit 58 has three structurally identical, freely extending spring pieces 110 extending in the circumference direction 50, 52, each of which is connected integrally to a retaining ring 114 by means of a connecting piece 112 extending radially inward (Fig. 4). The connecting piece 112 and the spring piece 110 are essentially T-shaped, the spring piece 110 extending in an arc shape with two free ends and the connecting piece 112 adjoining the spring piece 110 in its middle. The spring piece 110 has a width 120 that decreases towards its free ends 116, 118 and has a thickness 126 of approx. 0.9 mm. The leaf spring unit 58 rests with its retaining ring 114 against the drive flange 10; starting from the connecting piece 112 and extending toward their free ends 116, 118, the spring pieces 110 are each curved in the direction oriented away from the drive flange 10 and are supported against the tabs 68 of the sheet metal plate 48. In order to avoid a linear contact, contact surfaces 122, 124 that are comprised of flattened areas are formed onto the free ends 116, 118 or else the free ends 116, 118 of the spring pieces 110 are bent slightly in the direction of the drive flange 10.

In order to prevent an incorrect assembly, in particular a laterally offset installation of the leaf spring unit 58, next to the connecting pieces 112, the outer

circumference of the retaining ring 14 has encoding means 128 formed onto it, which extend radially outward and correspond to the clamping hooks 56 and pins 20 of the drive device 12 during assembly. If the leaf spring unit 58 is installed in a laterally offset position, the clamping hooks 56 of the sheet metal plate 48 can
 5 in fact be guided through recesses in the leaf spring unit 58 in a laterally offset position, but then the pins 20 of a drive disk 96 can no longer be guided through the leaf spring unit 58 due to the presence of the encoding means 128.

After the sheet metal plate 48 with the clamping hooks 56 formed onto it,
 10 the leaf spring unit 58, and the drive flange 10 have been preassembled, then a spring element 18 comprised of a helical compression spring and the drive disk 96 with its three pins 20, which are distributed uniformly over the circumference and extend in the axial direction 54, are slid onto the drive shaft 16 (Fig. 2).

15 Then, the preassembled unit comprised of the sheet metal plate 48, the leaf spring unit 58, and the drive flange 10 is mounted onto the drive shaft 16. During assembly, the pins 20 are guided by tabs 68, which are formed onto the circumference of the sheet metal plate 48 and contain bores 70, and are also guided by bores 72, which are situated in the drive flange 10; in the assembled
 20 state, the pins 20 reach through the bores 72. The form-locking elements 100 on the drive shaft 16 are inserted into the form-locking elements 106 of the drive flange 10. In addition, shapes 134 extending radially inward from the inner circumference of the drive disk 96 are inserted into grooves 62 let into the outer circumference of the drive flange 10. The pins 20 prevent the sheet metal plate
 25 48 and drive disk 96 from rotating in relation to each other.

The drive device 12 is secured to the drive shaft 16 with a screw 74. The insert tool 14 comprised of a cutting wheel has an essentially disk-shaped sheet metal hub 42 comprised of a separate component, which has three cup-shaped
 30 recesses 76 uniformly distributed one after another in the circumference direction

50, 52 and extending in the axial direction 54, whose diameter is slightly larger than the diameter of the pins 20. The sheet metal hub 42 also has three openings 78 that are uniformly distributed in the circumference direction 50, 52 and extend in the circumference direction 50, 52, each having a narrow region 80 and a wide region 82.

The diameter of the centering bore 46 of the sheet metal hub 42 is selected so that it is also possible to clamp the insert tool 14 to a conventional angle grinder using a conventional clamping system equipped with a clamping flange and a spindle nut. This assures so-called backward compatibility.

The sheet metal hub 42 of the insert tool 14 has three shaped elements 24, which are distributed uniformly in the circumference direction 50, 52 over the circumference of the centering bore 46 (Fig. 2). The shaped elements 24 here are embodied in the form of recesses.

The shaped elements 22 of the tool-holding device and the shaped elements 24 of the insert tool 14 are reciprocally matching, corresponding shaped elements designed to facilitate mounting of the insert tool 14. In addition, the corresponding shaped elements 22, 24 constitute an encoding means to prevent installation of an inadmissible insert tool of the same kind. To this end, the corresponding shaped elements 22, 24 are matched to each other with regard to a diameter of the insert tool 14 so that insert tools intended for insertion into high-speed machines have a wide shaped element or a wide encoding means and insert tools intended for insertion into lower-speed machines have a narrow shaped element or a narrow encoding means.

The sheet metal hub 42 of the insert tool 14 is firmly attached to and pressed together with an abrasive via a riveted connection and is cup-shaped due to the presence of a formation 44 oriented in the axial direction 64.

When the insert tool 14 is being mounted, the insert tool 14 is slid with its centering bore 46 onto the part of the collar 26 protruding beyond the shaped elements 22 in the axial direction 54 and is radially precentered. In the process of this, the insert tool 14 comes to rest against contact surfaces 84 of the shaped elements 22. Rotating the insert tool 14 in the circumference direction 50, 52 brings the shaped elements 22, 24 into alignment. The insert tool 14 and/or the sheet metal hub 42 can then slide in the axial direction 64 toward the contact surface 30 and the sheet metal hub 42 comes to rest against the pins 20.

A subsequent pressing of the sheet metal hub 42 against the contact surface 30 of the drive flange 10 causes the pins 20 to slide into the bores 72 and causes the drive disk 96 to be slid axially in the direction 64 oriented away from the insert tool 14, counter to a spring force of the spring element 18 on the drive shaft 16. This causes shapes 86 oriented radially outward on the drive disk 96 to travel into corresponding locking pockets 88 of a support flange 90 connected to the transmission housing 38 and lock the drive shaft 16.

When the sheet metal hub 42 is pressed down against the contact surface 30, the clamping hooks 56 automatically travel into the wide regions 82 of the openings 78 in the sheet metal hub 42.

If the hook-shaped extensions of the clamping hooks 56 are guided through the wide regions 82 of the openings 78 of the sheet metal hub 42 and the sheet metal hub 42 is fully depressed, then the sheet metal hub 42 can be rotated counter to a drive direction 98. The rotation of the sheet metal hub 42 on the one hand permits the rim of the centering bore 46 of the sheet metal hub 42 to be slid into the space 28 between the shaped elements 22 and the contact surface 30 of the drive flange 10 and also permits the shaped elements 22 to prevent it from falling down in the axial direction. On the other hand, the rotation

of the sheet metal hub 42 causes the hook-shaped extensions to slide into the arc-shaped, narrow regions 80 of the openings 78 of the sheet metal hub 42. In the course of this, beveled surfaces that are not shown in detail allow the sheet metal plate 48 with the clamping hooks 56 to slide axially in the direction 54, counter to the pressure of the leaf spring unit 58, until the contact surfaces of the hook-shaped extensions come to rest in the arc-shaped, narrow regions 80 situated laterally next to the openings 78 of the sheet metal hub 42. For self-cleaning purposes, the contact surface 30 of the drive flange 10 is provided with arc-shaped grooves, which can convey undesirable particles on the contact surface 30 outward, ejecting them from the drive device 12.

In an operating position of the insert tool 14, the pressure of the spring element 18 causes the drive disk 96 to slide upward. The pins 20 engage in the cup-shaped recesses 76 of the sheet metal hub 42 and secure it in a form-locked manner in the circumference direction 50, 52. At the same time, the shapes 86 of the drive disk 96 disengage from the locking pockets 88 of the support flange 90 and release the drive shaft 16.

In order to remove the insert tool 14, a release button 92 is pushed in the axial direction 64. The release button 92 presses to the drive disk 96 in the axial direction 64 and the shapes 86 of the drive disk 96 engage with the locking pockets 88. The drive shaft 16 is locked in position. This causes the pins 20 to disengage from the recesses 76 of the sheet metal hub 42, permitting the sheet metal hub 42 to be rotated in the circumference direction 52 until the clamping hooks 56 can slide a through the openings 78. This causes the shaped elements 22, 24 to move into a corresponding position and permits the sheet metal hub 42 to be removed in the axial direction 54.

10	drive flange	60	opening
12	drive device	62	groove
14	insert tool	64	axial direction
16	drive shaft	66	groove
18	spring element	68	tab
20	locking element	70	bore
22	shaped element	72	bore
24	shaped element	74	screw
26	collar	76	recess
28	distance	78	opening
30	contact surface	80	region
32	angle grinder	82	region
34	housing	84	contact surface
36	handle	86	shape
38	transmission housing	88	locking pocket
40	handle	90	support flange
42	hub	92	release button
44	shape	94	beveled surface
46	centering bore	96	drive disk
48	sheet metal plate	98	drive direction
50	circumference direction	100	form-locking element
52	circumference direction	102	longitudinal span
54	axial direction	104	height
56	clamping hook	106	form-locking element
58	leaf spring unit	108	spacer element

- 110 spring piece
- 112 connecting piece
- 114 retaining ring
- 116 end
- 118 end
- 120 width
- 122 contact surface
- 124 contact surface
- 126 thickness
- 128 encoding means
- 130 collar
- 132 transition
- 134 shape
- 136 internal thread